

Chapter 5

Specifying Wire Rope

This chapter presents the standard nomenclature used for ordering wire rope, and information on requirements necessary to specify wire rope for Corps of Engineers gate-operating devices. It also presents information on availability and cost.

5-1. Standard Nomenclature

Standard wire rope specification nomenclature gives the following rope requirements: length, direction and type of lay, diameter, finish, classification, material, preformed or non-preformed, and core type.

For example, a rope manufacturer would consider the following description of a wire rope to be complete:

a. Metric: 152.3 M 38 mm 6x19 Seale pref RLL Galv Improved Plow Steel IWRC.

b. English: 500 ft 1-1/2" 6x19 Seale pref RLL Galv Improved Plow Steel IWRC.

5-2. Additional Requirements

Additional requirements for wire rope that should be considered for inclusion in the specifications:

a. Wire Strength and Ductility. Manufacturers occasionally blend stronger and weaker wires in one rope which can have detrimental effects on its fatigue resistance (See Section 2-8 "Manufacturing"). Test procedures for strength and torsion (included in Appendix C) assure that fatigue resistance will not suffer because of this practice.

b. Rope tension test. New wire rope should meet the industry accepted nominal strengths. However, it is standard practice to require a rope tension test, to failure, for verification that the expected performance level has been met. The procedure is as follows. The sample length is cut to not less than 0.91 m (3 ft) for rope diameters between 3.2 mm (1/8 in.) and 77 mm (3 in.). The test is only considered valid if failure occurs at least 51 mm (2 in.) from either the socket or

holding mechanism. The relative speed between the testing machine heads (while tensioning) is not allowed to exceed 25 mm (1 in.) per minute.

c. Verification of preforming. Preforming should be specified for any steel wire rope for any gate-operating device. The standard test from Federal Specification 410 to verify preforming is as follows. First measure a rope's diameter, then remove the seizing at one end of the rope and again measure its diameter. The difference in diameters may not be more than the values indicated in the table in Appendix C.

d. Stress relief verification. The standard wrapping test from Federal Specification 410 verifies that stress relief has been accomplished. It applies to rope with either bare steel or galvanized steel wires. The procedure is as follows. Rope wires are wrapped in a helix about a mandrel for six complete turns, followed by unwrapping. No wires may break or fracture. The mandrel for bare and galvanized steel is two times the diameter of the wire.

e. Weld distribution. Welded (or brazed) wire joints should not be any closer than 45.7 cm (18 in.) in any strand.

f. Zinc coat test. Appendix C contains recommendations on the amount of zinc required for effective corrosion control for wire rope. It also contains a test procedure from Federal Specification 410 for determining the weight of the zinc coating on wire rope.

g. Pre-stretching. As explained in Section 2-8, "Manufacturing," this procedure is recommended for installations with multi-rope drums. The standard procedure and a new dynamic procedure is discussed in that paragraph.

h. Lubrication. The designer/specifier must decide if a lubricant will be used with the rope being supplied, and if so, what type of lubricant is needed (Section 7-3, "Lubrication"). If a lubricant will be used, having it applied at the rope manufacturer's facilities is recommended. The manufacturer will generally have equipment which can force the lubricant into the core area of a rope.

i. *Pitch length.* A strand pitch of not less than 4-1/2 times the nominal rope diameter is normally required for the ropes used in gate-operating devices.

j. *Attaching and proof-loading terminations.* As discussed in Section 3-1, "Sockets," it is recommended that swaged and speltered sockets be attached at the rope manufacturer's facilities and also be proof loaded prior to use. Proof loading is normally at 200 percent of the expected load (operating gate) or 40 percent of the nominal strength of the rope. It is practical to perform the proof testing as a part of a pre-stretching operation. Manufacturers should be consulted to decide if existing sockets can be reused.

k. *Core wires (IWRC).* The number of wires in the core strand should be equal to or greater than the number of wires in the other strands. The wires should be of the same material as the wire in the other strands or of a material with a lower tensile strength.

l. *Field acceptance.* The designer/specifier should add several requirements as discussed in Section 6-1, "Field Acceptance," to be certain that the rope purchased will be delivered and installed in good condition.

5-3. Availability/Cost

The cost and availability of the options must be considered in the selection process. For example, sizes larger than 38 mm (1-1/2 in.), some constructions, and most stainless steel rope are not readily available off the shelf. Extra delivery time will likely be required for any special order rope. Availability needs to be discussed with manufacturers early in the selection process. Also, quantities of 3,000 m (10,000 ft) and more are generally required for a standard production run. Runs for smaller quantities will have higher prices per unit length. There is a fixed amount of waste for any run due to normal production methods. Flat and other special shaped rope may not be available at any cost. Figures 5-1 through 5-3 present relative cost data for rope of various materials, types of construction, and sizes.

| Rope Material | Relative Cost |
|---------------------------------------|---------------|
| Iron or Extra Strength Traction Steel | 0.40 – 0.50 |
| Improved Plow Steel | 0.96 – 0.98 |
| Extra Improved Plow Steel | 1.00 |
| Galvanized Improved Plow Steel | 1.25 – 1.35 |
| Stainless | 2.5 – 3.10 |

Figure 5-1. Relative cost data (per unit length) for wire rope of various materials

| Rope Construction | Relative Cost |
|--------------------------|---------------|
| <u>6 x 19 Class FC</u> | 0.93 |
| 6 x 19 FC | |
| 6 x 21 FC | |
| 6 x 25 FC | |
| 6 x 26 FC | |
| <u>6 x 19 Class IWRC</u> | 1.00 |
| 6 x 19 | |
| 6 x 21 | |
| 6 x 25 | |
| 6 x 26 | |
| <u>6 x 37 Class FC</u> | 1.08 |
| 6 x 31 FC | |
| 6 x 36 FC | |
| 6 x 41 FC | |
| 6 x 49 FC | |
| <u>6 x 37 Class IWRC</u> | 1.15 |
| 6 x 31 IWRC | |
| 6 x 36 IWRC | |
| 6 x 37 IWRC | |
| 6 x 41 IWRC | |
| <u>Flattened Strand</u> | 1.65 |
| <u>FC or IWRC</u> | |
| 6 x 25 Type B | |
| 6 x 30 Type G | |

Figure 5-2. Relative cost data (per unit length) for wire rope of various constructions

| Nominal Rope Size | | |
|-------------------|----|---------------|
| in. | mm | Relative Cost |
| 1/2 | 13 | .38 |
| 5/8 | 16 | .47 |
| 3/4 | 19 | .64 |
| 7/8 | 22 | .82 |
| 1 | 26 | 1.00 |
| 1 1/8 | 29 | 1.20 |
| 1 1/4 | 32 | 1.43 |
| 1 3/8 | 35 | 1.72 |
| 1 1/2 | 38 | 2.06 |
| 1 5/8 | 42 | 2.47 |
| 1 3/4 | 45 | 2.92 |
| 1 7/8 | 48 | 3.33 |
| 2 | 51 | 3.78 |
| 2 1/8 | 54 | 4.34 |
| 2 1/4 | 57 | 4.97 |
| 2 3/8 | 60 | 5.43 |
| 2 1/2 | 64 | 5.88 |

Figure 5-3. Relative cost data (per unit length) for wire rope of various sizes

5-4 Buy American

The best wire rope has traditionally been and still is manufactured in the U.S. Note that all domestic made rope is color coded within the strands with the specific manufacturer's colors for easy identification. However, the number of major U.S. wire rope manufacturers has decreased from more than one dozen in 1975 to 5 in 1996. A high portion of the wire rope of foreign manufacture has given unsatisfactory service. Although some of the western European countries have manufacturers which produce good rope, buying foreign made rope is risky. It is highly recommended that wire rope for Corps gate-operating devices be required to have been manufactured in the U.S. The contract specifications for this requirement should conform to Part 25 of the Federal Acquisition Regulations.